With the availability of a vast number of chemicals and drugs, acute poisoning is a common medical emergency in any country. The exact incidence of this problem in our country remains uncertain but it is estimated that about 10-15 million cases of poisoning are reported every year, of which, more than 50,000 die. The objective of this article is to familiarize the physicians about various steps required in the effective management of patients with acute poisoning.

For effective management of an acutely poisoned victim, five complementary steps are required. These are:

1. Resuscitation and initial stabilization
2. Diagnosis of type of poison
3. Nonspecific therapy
4. Specific therapy
5. Supportive care

Resuscitation and Initial Stabilization

On arrival of a patient with poisoning, the initial priorities are the maintenance of airway, breathing and circulation. If the patient has an altered level of consciousness, his cervical spine must be immobilized till an injury can be ruled out. If respiratory inadequacy is present, endotracheal intubation is required. Hypotension in poisoned patients is most often due to loss of fluids or toxin-induced vasodilatation. Hence, crystalloids are the first choice of treatment of hypotension. Before infusing fluids, blood should be withdrawn for investigations (including sugar, urea, electrolytes and acid-base status). Rectal temperature should be obtained in all patients with altered sensorium.

After initial resuscitation, all patients with altered sensorium should receive a 'cocktail' of 50% dextrose, naloxone and thiamine. However, recently, empiric administration of dextrose has been questioned. Experiments in animals have shown that administration of dextrose in both pre- and post-cardiac arrest conditions was associated with worse neurologic recovery1,2. At present, it is recommended to check the blood sugar using a reliable bedside test and to administer dextrose only if the blood sugar is below 80 mg/dl. However, if the sticks are not available, it is still advisable to administer dextrose to all patients with altered sensorium, including those with focal neurologic deficits3,4.

Another component of the 'cocktail' recommended in patients with altered mental status is naloxone. It is able to rapidly counteract the sedation and respiratory depression induced by opiates. The dose is 2 mg in all age groups. However, if the patient is an opioid addict and is not apnoeic, the initial dose may be reduced to avoid withdrawal features5. Naloxone can occasionally produce side effects in the form of hypertension, pulmonary oedema, arrhythmias, seizures and cardiac arrest. It can also precipitate the withdrawal reaction.

Diagnosis of Type of Toxin

History : The history should be elicited from the patient as well as his relative. Occupational history and availability of potential poisons at home should also be asked for. However, it is very important not to believe the patient blindly particularly those who have ingested poison with a suicidal intent.

Examination : Once the patient has been stabilized, a thorough head-to-toe examination should be conducted. The objectives of this examination are two-fold: to diagnose the type of poison and to detect any associated trauma.
Based on the examination findings, it may be possible to identify the type of poison involved (Table I).

**Table I : Clinical Features and Associated Poisons**

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>Poisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odour of Breath</td>
<td>Chloroform, Ethanol, Cyanide, Arsenic, Organophosphates, Phosphorus, Kerosene</td>
</tr>
<tr>
<td>Hypertension with Tachycardia</td>
<td>Amphetamines, Cocaine, LSD, MAO inhibitors, Marijuana, Phencyclidine, Alcohol withdrawal, Nicotine, Antihistamines, Antipsychotic agents, Antidepressants</td>
</tr>
<tr>
<td>Hypotension with bradycardia</td>
<td>Narcotics, Benzodiazipines, Cyanide, Nicotine, Organophosphates</td>
</tr>
<tr>
<td>Hypotension with tachycardia</td>
<td>Aluminium phosphate, Antipsychotics, Caffeine, Cyanide, Disulfiram-ethanol interaction, Tricyclic antidepressants</td>
</tr>
<tr>
<td>Hyperthermia</td>
<td>Amoxapine, Amphetamines, Antidepressants, Cocaine, Lithium, LSD, MAO inhibitors, Phencyclidine, Anticholinergic agents, Salicylates, Anticholinesterase inhibitors</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>Antidepressants, Ethanol, Benzodiazipine, Narcotics, Barbiturates, Phenothiazines</td>
</tr>
<tr>
<td>Tachypnoea</td>
<td>Amphetamines, Atropine, Cocaine, Salicylates, Carbon monoxide, Cyanide, Hepatic Encephalopathy (paracetamol, amatoxin mushrooms), Metabolic acidosis</td>
</tr>
<tr>
<td>Bradypnoea</td>
<td>Antidepressants, Antipsychotic agents, Barbiturates, Ethanol, Benzodiazipines, Chlorinated hydrocarbons, Narcotics, Nicotine, Organophosphates, Cobra bites</td>
</tr>
<tr>
<td>Altered sensorium</td>
<td>Antidepressants, Antihistamines, Antipsychotics, Atropine, Organophosphates, Barbiturates, Lithium, Cyanide, Benzodiazipines, Ethanol, Narcotics, Carbon monoxide</td>
</tr>
<tr>
<td>Seizures</td>
<td>Antidepressants (amoxapine and maprotiline), Antipsychotic, Antihistamines, Chlorinated hydrocarbons, Organophosphates, Cyanide, Lead and other heavy metals, Lithium, Narcotics, Sympathomimetics (amphetamines, cocaine, phencyclidine)</td>
</tr>
<tr>
<td>Miosis</td>
<td>Barbiturates, Phenothiazines, Ethanol, Narcotics, Nicotine, Organophosphates</td>
</tr>
<tr>
<td>Mydriasis</td>
<td>Amphetamines, Caffeine, Cocaine, LSD, MAO inhibitors, Nicotine, Antidepressants, Antihistamines, Atropine</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>Methaemoglobinemia-inducing agents, Terminal stages of all poisonings</td>
</tr>
</tbody>
</table>

Laboratory Investigations: A few simple bedside tests are helpful in diagnosing the chemical ingested. A pinkish colour of urine occurs in phenothiazine intoxication, as well as in myoglobinuria and haemoglobinuria. Chocolate-coloured blood is indicative of methaemoglobinaemia. Presence of oxalate crystals in urine is typical of ethylene glycol ingestion. Ketonuria without any metabolic change occurs in isopropyl alcohol and acetone intoxication while ketonuria with metabolic acidosis is suggestive of salicylate poisoning.

Abdominal X-ray may be useful in diagnosing certain radiopaque toxins which include chloral hydrate, heavy metals, iron, iodides, phenothiazines, sustained-release preparations and solvents (chloroform, carbon tetrachloride). However, one must not exclude a poisoning on the basis of absence of radiopaque density on X-ray.

**Non-specific Treatment**

The next step in the management of a poisoned patient is to remove the unabsorbed poison from the gut and increase the excretion of absorbed poison from the body.

**Gastric Decontamination**

Removal of unabsorbed poison from the gut can be achieved by several means including induction of emesis, gastric lavage, and use of activated charcoal and cathartics.

Before performing a procedure for gastric emptying, it is important to consider:

i) Whether the ingestion is potentially dangerous,
ii) Can the procedure remove a significant amount of toxin, and
iii) Whether the benefits of a procedure outweigh its risks?

If the patient has ingested a non-toxic agent, non-toxic dose of a toxic agents, or if he is free of symptoms despite passage of time during which the toxin is known to produce features of toxicity, gastric emptying is unnecessary. However, if the patient has ingested a high-risk toxin (cyanide, paracetamol), gastric emptying is indicated even
if he is asymptomatic. Gastric emptying is also not indicated if the patient had prior repeated vomiting or the toxin is absorbed rapidly, or patient presents late after ingestion. However, some toxins (antidepressants, phenothiazines, salicylates, opioids, phenobarbital and anticholinergics) delay gastric emptying. Gastric emptying is also delayed in comatose patients. It is also delayed if the toxin forms a mass in the stomach. In these situations, a delayed gastric emptying may be performed though there is no evidence to support this. If the risks of a procedure outweigh the possible benefits, it should be avoided (e.g., ingestion of volatile hydrocarbons, caustics).6

Syrup of ipecac: Syrup of ipecac is used to induce emesis with the intention to remove the poison from the stomach. It was recommended in all patients with poisoning. The value of syrup of ipecac has been investigated in animal and human studies. The amount of recovery of toxin has been highly variable, and after one hour the amount is insignificant. Thus, presently, ipecac may be considered in an alert conscious patient who has ingested a potentially toxic amount of a poison within the last one hour.7 It should be avoided in ingestion of hydrocarbons and corrosives. This compound, however, is not available in India.

Gastric lavage: For inserting an orogastric lavage tube, the patient should be placed in left lateral position with the head-end lowered. This will prevent aspiration and also reduce the entry of lavage fluid and poison into duodenum. If patient is unconscious, endotracheal tube must be inserted before lavage tube insertion in order to protect against aspiration into the lungs. A large bore tube (36 F in adults) is inserted into the stomach and its position is checked by injecting air through the tube into stomach and simultaneously auscultating over the epigastrium. The lavage is then performed by using fluid aliquots of 3-4 ml/kg. In adults, tap water at room temperature may be sufficient. However, in young children, isotonic saline at 37°C is preferable in order to prevent chances of hypothermia and hyponatraemia. The lavage is continued till the return is clear. A lavage is contraindicated following ingestion of strong caustics, non-toxic agents and volatile hydrocarbons.

Gastric lavage is routinely performed in all patients with poisoning. However, studies conducted on animal, volunteer and human poisoning cases do not support the routine use of lavage in all patients with poisoning. Even in comatose patients, where gastric emptying is delayed, studies have shown lavage to be potentially dangerous and of little value in most cases. Therefore, it is recommended that gastric lavage should not be considered unless the patient has ingested a potentially life-threatening amount of poison and the lavage can be undertaken within 60 minutes of ingestion.8 However, due to non-availability of activated charcoal in India, it may still be considered within 2 hours of ingestion of potentially toxic agents.

Cathartics: Cathartics have been used for several years with the hope of increasing the excretion of the toxins from the gut. Commonly used cathartics are: magnesium sulphate (30 g for adults and 250 mg/kg in children), magnesium citrate (4 ml/kg up to a maximum of 300 ml) and sorbitol (1 g/kg as 70% solution). Sodium phosphate should not be used as it can lead to phosphate poisoning. Oil-based cathartics are contraindicated as they increase the absorption of several toxins. In addition, repetitive doses of these agents should be avoided. Important complications include electrolyte imbalance, dehydration, and in case of sorbitol, abdominal distension. Cathartics are contraindicated in presence of ileus, intestinal obstruction, renal failure, hypotension, severe diarrhoea and abdominal trauma. Despite theoretical benefits, there is no data to support their efficacy and their use cannot presently be recommended.

Activated Charcoal: Use of activated charcoal has revolutionized the treatment of poisoning. Due to its small particle size and enormous surface area, it can adsorb large amount of toxins.
usual dose is 1 g/kg body weight or 10 parts of charcoal for every one part of toxin, whichever is greater. Activated charcoal is contraindicated in patients with unprotected airway and caustic ingestion. Although it is not effective in adsorbing lithium, iron, DDT, methanol, ethanol, metals and hydrocarbons, it is not contraindicated in these ingestions and may be given if a co-ingestion is suspected.

Based on the results of the volunteer studies, activated charcoal is likely to be beneficial if administered within 60 minutes of toxin ingestion. Therefore, in such situations, it may be considered beyond 1 hour but the data is insufficient to support or exclude its use. Unfortunately, activated charcoal is not available in India.

Whole bowel irrigation: In this method, isotonic solution of polyethylene glycol-electrolytes is administered orally in a dose of 2 litres/hour in adults and 0.5 litres/hour in children. The procedure is continued for 4-6 hours or till the rectal effluent is clear. The components of this solution are not absorbed through the intestines. Instead, the solution flushes the gut mechanically. At present, there are no established indications for the use of whole bowel irrigation. Based on the experimental studies, WBI is an option for potentially toxic ingestions of sustained release or enteric coated drugs. It has a theoretical value in the management of iron ingestion and ingestion of drug packets. It is also of theoretical value if the toxin is not adsorbed by activated charcoal.

Enhancing Excretion

Once the absorption of a toxin has been reduced by various methods, the next logical step is to enhance the elimination of already absorbed toxin from the body. Important methods for this purpose are forced diuresis with alteration in urinary pH, multiple doses of charcoal, peritoneal and haemodialysis, haemoperfusion, haemofiltration and exchange transfusion.

Forced alkaline diuresis: One of the commonly used methods to increase the elimination of a toxin is forced diuresis with alteration in urine pH. Renal excretion of a substance is dependent upon glomerular filtration rate, active renal tubular secretion and passive tubular reabsorption. The glomerular filtration is determined by the molecular weight, the degree of protein-binding and the volume of distribution in the body. A large volume of distribution means that only a small amount of a chemical is available for filtration and therefore, forced diuresis is of little help. Because of these reasons, most of the chemicals (except isoniazid and bromides) are not amenable to removal by forced diuresis alone. The renal tubular epithelium is relatively impermeable to the ionized molecules. If the urinary pH is changed so as to produce more of ionized form of a chemical, it is trapped in the tubular fluid and is excreted in the urine. This is the basis for alkaline diuresis which is useful in salicylates, phenobarbital and lithium intoxication.

For alkaline diuresis, 5% dextrose in half-normal saline containing 20-35 mEq/L of bicarbonate is administered at a rate so as to produce a urine output of 3-6 ml/kg/hour and a urine pH 7.5-8.5. Diuretics are often needed to maintain high urine flows. To prevent hypokalaemia, potassium should be added in every second or third bottle. During forced alkaline diuresis, the vitals of the patient along with input/output, electrolytes and acid base status should be closely monitored. This procedure is contraindicated in patients with shock, hypotension, renal failure and congestive heart failure.

Multiple-doses of activated charcoal: Multiple doses of activated charcoal have been recommended in treating certain poisonings. Because of multiple doses, free charcoal is available in the intestines to bind any toxin which has significant enterohepatic circulation. Further, free toxin in the blood tends to diffuse out of the blood into the intestines where it binds the charcoal, thereby maintaining the concentration of free toxin in the intestines near zero. This is termed “gastrointestinal dialysis”. Depending upon the severity of poisoning, the doses are: 0.5-1 g/
kg body weight every 1-4 hours. Multiple doses of charcoal are indicated in following conditions:

(a) If the toxin has a long half life;
(b) If the toxin has a significant enterohepatic circulation (digoxin, phenobarbital, theophylline);
(c) If continuous release of toxin occurs from a sustained-release preparation;
(d) If a toxin forms a mass in the gut which is a source of continuous release of toxin; and
(e) If the ingestion is too massive to be effectively adsorbed by a single dose of charcoal.

However, repeated doses are contraindicated in the presence of ileus. In addition, repeated doses of cathartics must not be administered along with multiple doses of charcoal.

Dialysis: Peritoneal and haemodialysis are useful for water-soluble compounds of low molecular weight. Dialysis is useful in ethanol, methanol, salicylates, theophylline, ethylene glycol, phenobarbital and lithium intoxications. Peritoneal dialysis is a slow process and it should not be used if facilities for haemodialysis are available.

Table II: Antidotes and their use\(^6,14,15\)

<table>
<thead>
<tr>
<th>Antidote</th>
<th>Poison</th>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>Cholinesterase inhibitors</td>
<td>Initially, administer 2-4 mg for adults and 0.05 mg/kg for children. Repeat it every 5-15 minutes until there is cessation of oral and tracheal secretions. Then lower the dose and give at less frequent intervals to maintain atropinization for 24-48 hrs.</td>
</tr>
<tr>
<td>Pralidoxime</td>
<td>Organophosphates</td>
<td>1-2 gm (25-40 mg/kg in children) IV over 10-20 minutes. Repeated every 4-8 hours</td>
</tr>
<tr>
<td>Naloxone</td>
<td>Opiates</td>
<td>See under ‘Resuscitation’</td>
</tr>
<tr>
<td>Methylene blue</td>
<td>Methaemoglobinemia</td>
<td>1-2 mg/kg body weight as a 1% solution to be given slowly over 5 minutes intravenously. May be repeated after 1 hour</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Methanol, Ethylene glycol</td>
<td>Loading dose is 0.75 g/kg which is followed by maintenance dose of 0.1 g/kg/hr.</td>
</tr>
<tr>
<td>Deferoxamine</td>
<td>Iron</td>
<td>90 mg/kg (upto 1 gm) i.m. followed by 90 mg/kg (upto 1 gm) every 4-12 hours. If hypotension is present, give intravenously at a rate not more than 15 mg/kg/hour</td>
</tr>
<tr>
<td>Snake antivenin</td>
<td>Snake bites</td>
<td>Dose varies with the species of snake which has bitten and the severity of envenomation</td>
</tr>
<tr>
<td>BAL (Dimercaprol)</td>
<td>Lead, Arsenic, Mercury</td>
<td>300 mg/sq. meter/day in 6 divided doses (3-5 mg/kg every 4 hours) for 2 days, then 2.5-3 mg/kg every 6 hours for 2 more days, and then every 12 hours for 7 more days.</td>
</tr>
</tbody>
</table>

Supportive Therapy

Since the antidotes are available only for a few toxins, treatment of most cases of poisoning is largely supportive. It is important not to waste time in locating an antidote; instead supportive therapy should be instituted after which an attempt may be made to get the antidote. The aim of the supportive treatment is to preserve the vital organ functions till poison is eliminated from the body and the patient resumes normal physiological functions. Therefore, functions of central nervous system, cardiopulmonary system and renal system should be supported with proper care for coma, seizures, hypotension, arrhythmias, hypoxia, and acute renal failure. The fluid, electrolyte and acid-base status should be closely monitored in all patients.

Exposure to a Toxin through Routes other than Ingestion

Besides ingestion, a patient may be exposed to a toxin via cutaneous or ocular routes. This is quite common with pesticides and insecticides.

Specific Therapy

If the toxin can be identified, specific therapy using antidotes should be administered\(^{14,15}\). Important

antidotes, which are available in India, have been listed in table II.

**Specific Therapy**

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decontamination consists of removal of all the clothing of the patient and putting them in a plastic bag. Even the shoes and gloves should be removed. While doing so, the physician must protect himself by using aprons, gum boots, masks and gloves. After derobing, the patient should be washed with soap and copious amounts of water. Use of neutralizing agents is strongly contraindicated.

In case of ocular exposure, the eye should be irrigated with water for at least 20 minutes. An intravenous set tubing with the tip about 3 cm away from the eye may be used to flush the eyes.

Legal Responsibilities

Any physician can treat a victim of poisoning without any fear of legal implications provided he follows set rules. The first sample of gastric lavage and other relevant body fluids like urine and blood, should be collected in clean bottles. It is not mandatory to perform a gastric lavage; it may be omitted if not indicated. The bottles should be sealed using a glue paper. After sealing the bottles, particulars of the patient should be written on the seal and the signatures affixed on the label at the juncture between the cap and the bottle. All the relevant information and observations about the patient should be recorded carefully. After initial management, police should be informed about the case.

With the use of a systematic approach to the poisoned patients, the morbidity and mortality of these patients can be minimized.

References